Remarks:

Amendments have been made to the description and claims in order to overcome the Examiner's objections. Amendments to the description correct minor errors, and add explanation based on the drawings as filed, so do not involve new matter. Dealing with the Examiner's objections according to the numbered paras. of the Official Action:

Para.1.

In the drawings as now amended, Fig.2 has been amended to show the crossing point of flexures 44a and 44b as ref. 46. In Fig.3, the stops 54a and 54b are now correctly referenced.

Para.2.

Claim 10, and also claim 13, have been corrected to be dependent on claim 9.

Para.3.

The Examiner rejected claims 1-2, 5-6, and 8-11 on the basis of Applicant's prior US Pat. 5,239,599.

Claim 1 has been amended to be clearly distinguished over this prior patent. In the present invention all of the movements of the switch are accomplished by use of flexures. These have important advantages over the usual pivot bearings in that:

1) there is no play or slackness, even after the device has been in use for years, and 2) there is no friction.

In claim 1 as filed, it was stated that the switch was characterized in that the relative pivotal movement between the operating means (40) and the flexibly mounted support (16a, 16b) was provided entirely by flexure means. This was intended to refer to all of the movement between the supports (16a, 16b) and the operating means via the housing, i.e. as including the flexures 15 of the supports and the crossed flexures 44a and 44b of the operating means. It seems however that the Examiner may have taken this as equivalent to the connections shown in the '599 patent between the pivot member 34 and the rods 54, 56, and between these rods and the supports 58, 60. While these connections are achieved by flexures, however, it is noted that the mounting of the pivot member 34 and the housing in the prior patent is not achieved by a flexure but by the pivot 36 acting between recesses including recess 38; it is this kind of pivot which the present invention avoids. In this connection, reference is made to page 2, first main para. of the specification.

The amended claim 1 now recites the housing, and that the relative pivoting movements both between the operating means and the housing, and between the operating means and the flexibly mounted support, are achieved entirely by flexure means. This provides a clear distinction over the prior art.

Claim 2 has a minor amendment to accommodate the new wording of claim 1. It is believed allowable along with claim 1.

Claims 5 and 6 are dependent on claim 1 and are believed to be allowable therewith. Also,

these claims have been amended to recite that the operating means is a ferromagnetic armature, in practice a simple lever of steel, and the actuator means are electromagnetic. This provides another distinction over the '599 patent, where the equivalent operating means 34 carries a coil 32; this makes the operating means heavier than in the present invention and thus slower in operation.

As for claim 8 to 11, these claims, in addition to the feature of claim 1 which is incorporated into claim 8 by dependency, also claim the adjustment means for changing the width of the fiber gap. As set out in more detail in claim 9, these means include a flexible mount for the first support allowing axial movement of the first support relative to the optical fiber axis, and adjustment means for causing this axial movement. In the embodiment described in this application, the flexible mount for base portion 12 of the first support 16a is provided by the flexures 14 by which this part 12 is connected to the housing. The adjustment means for causing this movement are provided by the screw 60 which can move the base portion 12 axially in order to adjust the axial width of the gap.

Although the examiner has rejected claims 8 to 11 on the basis of the prior '599 patent, it is not seen that this prior patent gives any similar adjustment to the (axial) width of the gap. The Examiner refers to screws 48 and 50 as acting to adjust the width of the gap, but in fact these screws only adjust the lateral positions of the supports 58, 60, and do not adjust the axial width of the gap. These claims have been amended to specify that it is the axial width of the gap, i.e. as measured in the axial direction of the fiber, with which these claims are concerned, as well as axial movement of the first support.

Para.4.

Claims 1-2 and 5-6 were also rejected on the Applicant's prior US Pat. No.5,757,991. Similar comments apply as given above in relation to the '599 patent.

Thus, although the '991 patent shows flexible connections between the fiber supports 18, 20 and the housing or casing member 10, and between the supports 18, 20 and link members 44, 46, here the operating means is effectively the base 48 which moves pivotally relative to housing 10, and housing 10 is supported by shaft 12 movable in bearings 14 and 16. Thus, the essential movement which is produced is that between the housing 10 and the fixed base 48. The bearings 14 and 16 in effect correspond to the bearings 36, 38, etc. of the '599 patent, and these are not flexures as claimed in claim 1. Claims 2 and 5-6 of course incorporate the same limitations as claim 1.

Para. 5:

The allowance of claims 14–16 has been noted with appreciation. Claim 14 has however been amended to provide an antecedent for "said housing".

Para. 6.

Claims 3 and 12 have been re-written in independent form and are thus believed to be allowable, even if the broader claims were to be again rejected. Also, claim 7, as dependent on claim 3, is also believed to be allowable.

New claims:

New claims 17 to 21 have been added to further define the invention. Claim 17 is similar to

claim 1, but now recites that the operating means is in the form of a lever, and also recites the relationship of the actuator means and stop means as acting on outer portions of the lever which are situated outwardly from the connections to the link means so that the actuator means and stop means have a mechanical advantage over the link means. Claim 18 is similar to former claim 3, indicated as having allowable subject matter, and claim 19 adds the feature of former claim 5. Claims 20 and 21 are dependent claims similar to claims 8 and 12.

Prior Art of Record

The prior art made of record by the Examiner has been noted, and the following comments on this are submitted:

1) Harman (US 5,727,099) teaches an alignment controlling system using flexible mounts and screw adjustments: actuating force is applied through a compliant element. Fine movement control (leveraging) is provided through a ratio of stiffnesses as opposed to a pivotal operating member, which can give a mechanical advantage as in the present application.

2) Chang et al (US 6,044,186): teach a fiber switching apparatus comprising a pivoting mount and electromagnetic actuating means. Similar to Takahashi (see below) but it is a single 1X2 type. Uses a free space cantilevered fiber brought into alignment with a second axially spaced fiber based on contact with mirrored V-grooves. The fiber is carried by a pivotal member mounted on a standard fulcrum, rather than being held by a flexure joint.

3) Rosete et al. (US 6,385,365 B1) teach a fiber switching apparatus comprising a pivoting mount and electromagnetic actuating means. Pictures and claims are almost identical to Chang et al. Again, the pivoting member is not mounted by a flexure joint.

4) Takahashi (US 6,144,782) teaches a fiber switching apparatus comprising a motor actuator to move a support that aligns optical fibers. Cantilevered free-space fibers are moved so as to contact mirrored V-grooves. The fibers are moved by a support which is a thin member movable within a slit; this would be subject to friction, whereas friction is entirely eliminated in the applicant's construction. In this patent fibers are physically stopped by the V-grooves i.e. there is no leveraging to provide fine motion as in present application.

5) Thurenius et al. (US 4,610,504), teaches mechanical optical switches using moving platforms. This utilizes sliding platform 8 that holds the end portions of free-space cantilevered fibers. The free-spaces bodies of the fibers deflect as beams in a fixed-fixed cantilever configuration. This utilizes 1-to-1 movement against stops when slide 8 is caused to move by armature 4. Although flexures are present, it is stated that slide 8 "can glide with a certain friction" (col. 2, line 63), so clearly friction is not eliminated as in the present application.

6) Oguey et al (US 4,645,294) teaches mechanical optical switches using moving platforms. An attenuator not a switch. Attenuation uses axial gap separation moving in an arc: the mechanism is similar in form to a "clothes pin". Considerable modification would be needed to convert this into a

switch

7) Lemonde (US 4,759,597) teaches mechanical optical switches using moving platforms. A switch wherein a fiber is moved using a rocker arm with a frictional shaft as the hinge. The present application uses flexure hinges exclusively.

8) Lee (US 4,834,488): A moving fiber switch shown as a 2X2 using a "loop-back" fiber. It is comprised of fibers individually adhered to a fixed and rotationally movable member, said movable member being controlled by a stepping motor shaft which is rotatable in an ordinary bearing, such as bearing 124, rather than using flexures.

9) Lee (US 4,896,935): Similar to Lee (US 4,834,488) except in that the configuration is radially arranged to form a 1XN. This is a familiar Dicon Corp. 1XN switch patent

10) Valette et al (US 5,078,514) teaches optical switches comprising actuating means to rotate platforms containing fibers. Teaches a 1XN switch with central fiber mounted on a flexure structure. Fibers are individually aligned. Also teaches a "balanced" version with two fiber gaps. Simplified case (1X2) would use stops to control the motion. The flexure-mounted structure is moved by applying voltage to capacitor surfaces of the flexure and adjacent parts, rather than being moved by pivotal operating means connected to the flexure-mounted structure by links.

11) Delapierre (US 5,278,692) teaches optical switches comprising actuating means to rotate platforms containing fibers. A MEMS type etched structure with a small rotor. Fibers are individually aligned to waveguide structures. Movement of rotary part 10 appears to be achieved by a sliding frictional type bearing, and is not based on elastic flexure.

12) Lee (US 4,911,520) teaches an optical switch comprising a movable cantilever for a moving fiber up and down to align to fibers across a gap. Operation is by direct action of a solenoid; there is no equivalent to applicant's pivotal operating member and flexure-connected link means.

13) Nishiyama et al (US 6,169,826) Magnetic actuator and travel stops act directly on moveable support. There is no pivotal operating member connected by flexure links as in the present application, and also there is no leveraging.

14) Bona et al. (US 2003/0123787): this relates to a cross-connect switch in which fiber ends are mounted on a pivotal member connected by a flexure to an actuator which is caused to be bent by selective application of heat. There is no pivotal actuator as used in the present invention, and no leveraging. There are no stop means to precisely position the fibers, so a feedback system is needed for proper positioning.

15) Hagood et al. (US 6,738,539 B2): A small flexibly mounted block with a mounted fiber is moved pivotally in two axes by the direct application of force from orthogonally mounted actuators. This provides beam steering in a free-space beam switch using a collimating lens. There is no pivotal actuator as used in the present invention, and no leveraging. Also, as with Bona et al., there are no stops for accurate positioning.

16) Kubby (US 2004/0184720 A1) teaches different types of flexing supports used to align optical fibers for switching purposes. There is no pivotal actuator as in the present invention, and no mechanical advantage given by such actuator. It is noted that Kubby has a priority date of March 2003, which is later than that of the present application.

On the basis of these amendments, the applicant has addressed the concerns of the examiner and, it is submitted, that the applicant is seeking coverage which is both novel and unobvious over the cited references, and over the prior art generally. Accordingly, reconsideration and a favorable ruling which will allow this application to advance to Allowance is therefore requested.

Respectfully submitted

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Per: _____

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